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VICKSBURG MS INFORMATION TECHNOLOGY LAB C A MERRILL
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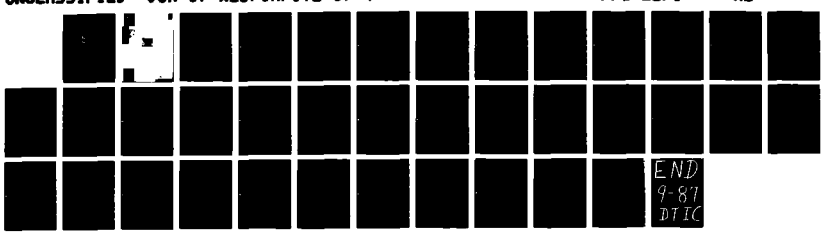

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This two-dimensional (2-D) frame analysis link program, LINK2D, provides the external link necessary for bridging the gap in data from rudimentary analysis design capabilities to data from more advanced structural analysis/design computer programs. The newly created data base could thereby be used throughout the building design process.

Data generated in STRUCTURE, a module of the Computer-Aided Engineering and Architectural Design System (CAEADS), have been used to create input data for CFRAME and/or the 2-D capability of GTSTRUDL.

CFRAME is a product of the Computer-Aided Structural Engineering (CASE) project and GTSTRUDL is a proprietary software program developed by and for the benefit of the Georgia Institute of Technology.

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19. ABSTRACT (Continued).

The meshing together of STRUCTURE, LINK2D, and CFRAME or GTSTRUDL into a building design process is discussed in the report as it outlines the steps for extracting data from STRUCTURE for use in LINK2D.

PREFACE

This report documents and describes the use of a computer program called LINK2D. This program uses the two-dimensional (2-D) frame data extracted from the STRUCTURE module of the Computer-Aided Engineering and Architectural Design System (CAEADS), originally developed by the Construction Engineering Research Laboratory, Champaign, Ill. These data are converted into the proper format for 2-D frame analysis programs. Currently, the only 2-D frame program formats are for the Computer-Aided Structural Engineering (CASE) program CFRAME, implemented at the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., and the commercial program GTSTRUDL, developed by the Georgia Institute of Technology, Atlanta, Ga.

This user's guide and computer program were written by Mr. Chris A. Merrill, Professional Engineer, of the Engineering Applications Group, formerly Computer Aided Group, Scientific and Engineering Application Division (SEAD), Automation Technology Center (ATC), WES. The work was sponsored through funds provided to WES by the Military Programs Directorate of the Office, Chief of Engineers (OCE), US Army, under the CASE Project.

Specifications for the program were provided by the members of the CASE Task Group on Building Systems. The following were members of the task group (although all may not have served for the entire period) during program development:

Mr. Dan Reynolds, Sacramento District (Chairman)
Ms. Anjana Chudgar, Louisville District
Mr. Joseph P. Hartman, Southwestern Division
Mr. George Henson, Tulsa District
Mr. David Illias, Portland District
Mr. Sefton Lucas, Memphis District
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Mr. Donald Dressler was the OCE point of contact. Overall guidance was provided at WES by Dr. N. Radhakrishnan, Acting Chief, Information Technology Laboratory (ITL), formerly Chief, ATC, and Mr. Paul K. Senter, Acting Chief, Information Research Division, ITL, formerly Chief, SEAD. Final editing for publication was done by Ms. Gilda Miller, Information Products Division, ITL, WES.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
foot-kips (force)	1355.818	newton-metres
inches	2.54	centimetres
inch-kips (force)	112.9848	newton-metres
kips (1,000 lb force)	4.448222	kilonewtons
kips (force) per foot	14.5939	kilonewtons per metre
kips (force) per inch	175.12685	kilonewtons per metre
kips (force) per square foot	47.88026	kilopascals
kips (force) per square inch	6.894757	megapascals
pounds (force)	4.448222	newtons
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre

USER'S GUIDE: 2-D FRAME ANALYSIS LINK PROGRAM (LINK2D)

PART I: INTRODUCTION

Purpose

1. The Computer-Aided Engineering and Architectural Design System (CAEADS) was developed by the Construction Engineering Research Laboratory, Champaign, Ill., to aid engineers in the preliminary design of buildings up to the 35 percent design level. STRUCTURE,* a module of CAEADS, allows the structural engineer to borrow the database created by the architectural module, to refine structural parameters and to layout a structural framing scheme. Sizes of structural members are determined assuming simple beam and column behavior. Thus, STRUCTURE incorporated only rudimentary analysis/design capabilities. Due to these limitations, the data created for this level of design could not easily be used during the final design phase of buildings.

Application

2. Externally linking these data to more advanced structural analysis/design computer programs would bridge this gap and allow the data base to be used throughout the building design process. LINK2D provides this external link by using data generated in STRUCTURE to create input data for CFRAME** and/or the two-dimensional (2-D) capability of GTSTRUDL.+

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* Gene McDermott. 1984. "STRUCTURE User's Manual," Construction Engineering Research Laboratory, Champaign, Ill.

** Joseph P. Hartman, John J. Jobst. 1979. "User's Guide Computer Programs with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)," IR 0-79-2, superseded by IR K-83-1, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

+ Georgia Institute of Technology. 1984. "GTSTRUDL User's Manual," Atlanta, Ga.

PART II: DESIGN PROCESS

3. The meshing of STRUCTURE, LINK2D, and CFRAME or GTSTRUDL into the building design process is shown in Figure 1. The structural engineer uses STRUCTURE to determine the optimum building framing scheme. Data common to all analysis programs are extracted for individual 2-D frames selected by the engineer. These data are converted by LINK2D into the specific format required by CFRAME and/or GTSTRUDL. Data conversion in LINK2D may be interactively monitored or may be done automatically.

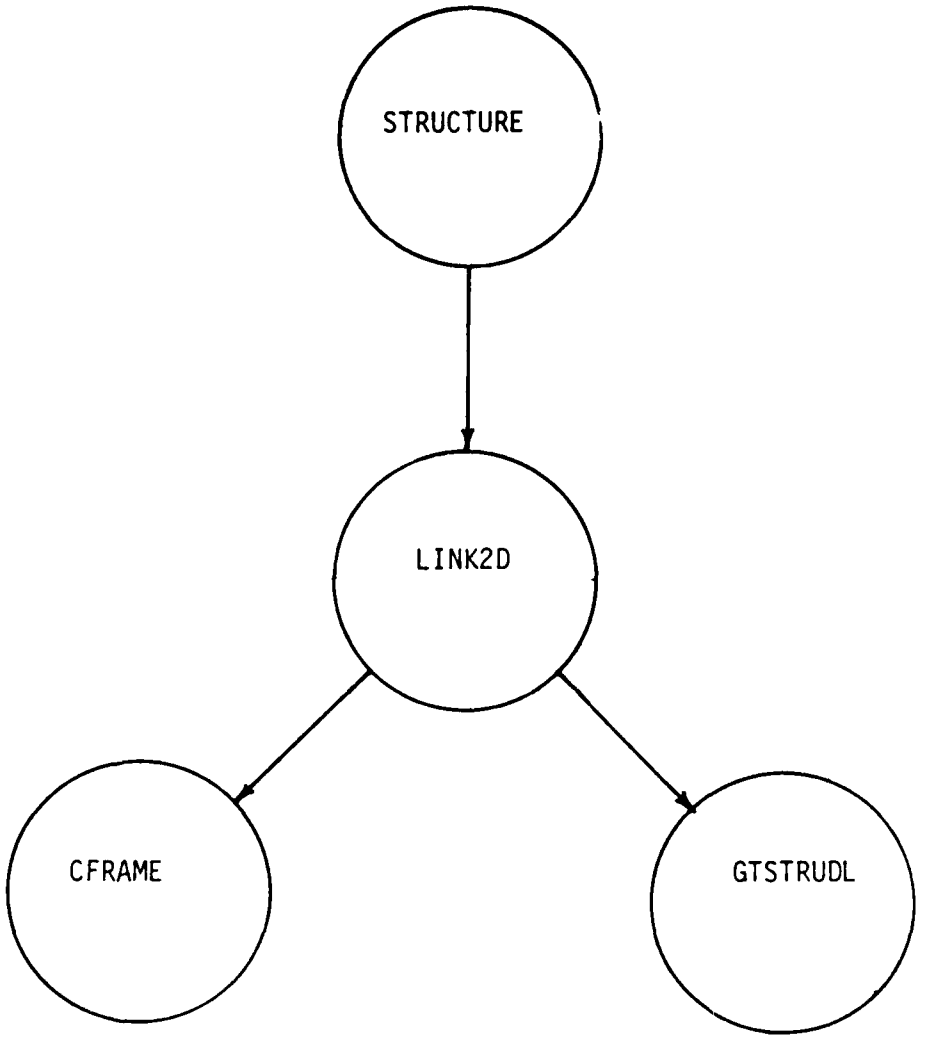


Figure 1. Meshing of programs into building design process

4. Refer to the "STRUCTURE User's Manual" for detailed information on program usage. Steps outlined in this part pertain only to extracting data from STRUCTURE for use in LINK2D. Note that all loads and member sizes must be initially determined in STRUCTURE before individual frame data can be extracted. Since STRUCTURE utilizes color graphics, it functions best on a Tektronix 4100 series color terminal; however a Tektronix 4014 terminal is adequate.

5. The following list describes the proper procedure for obtaining STRUCTURE data to be used in LINK2D:

a. Move the cross hairs to the menu area box labeled ANALYSIS (Figure 2) and press any key. The program will respond with "*ANALYSIS MODE".

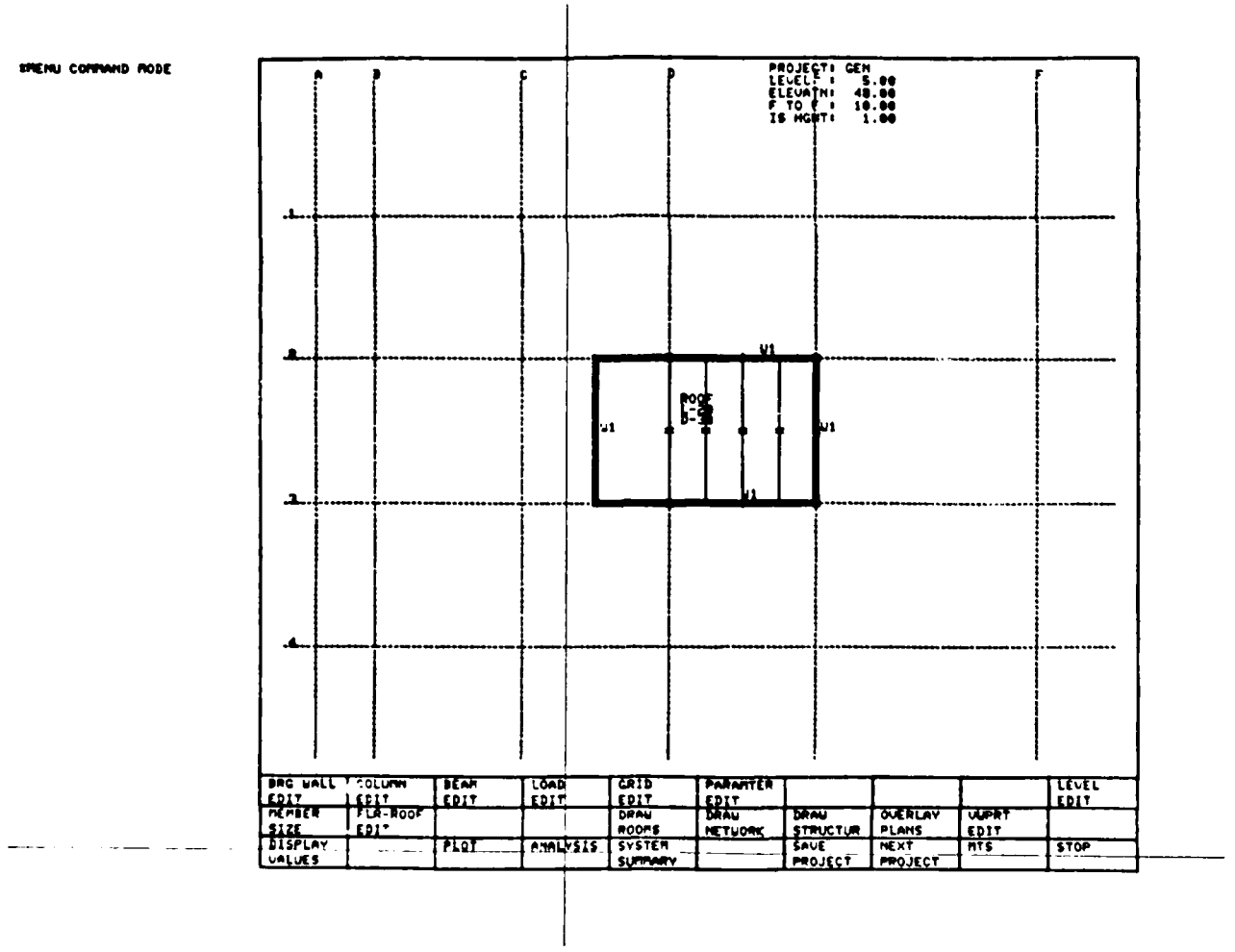


Figure 2. ANALYSIS MODE selection

b. Move the cross hairs into the graphics display area and press the F key. All options can be displayed by pressing L but only the F option is available (Figure 3). The program will respond with "LOCATE REFERENCE LINE".

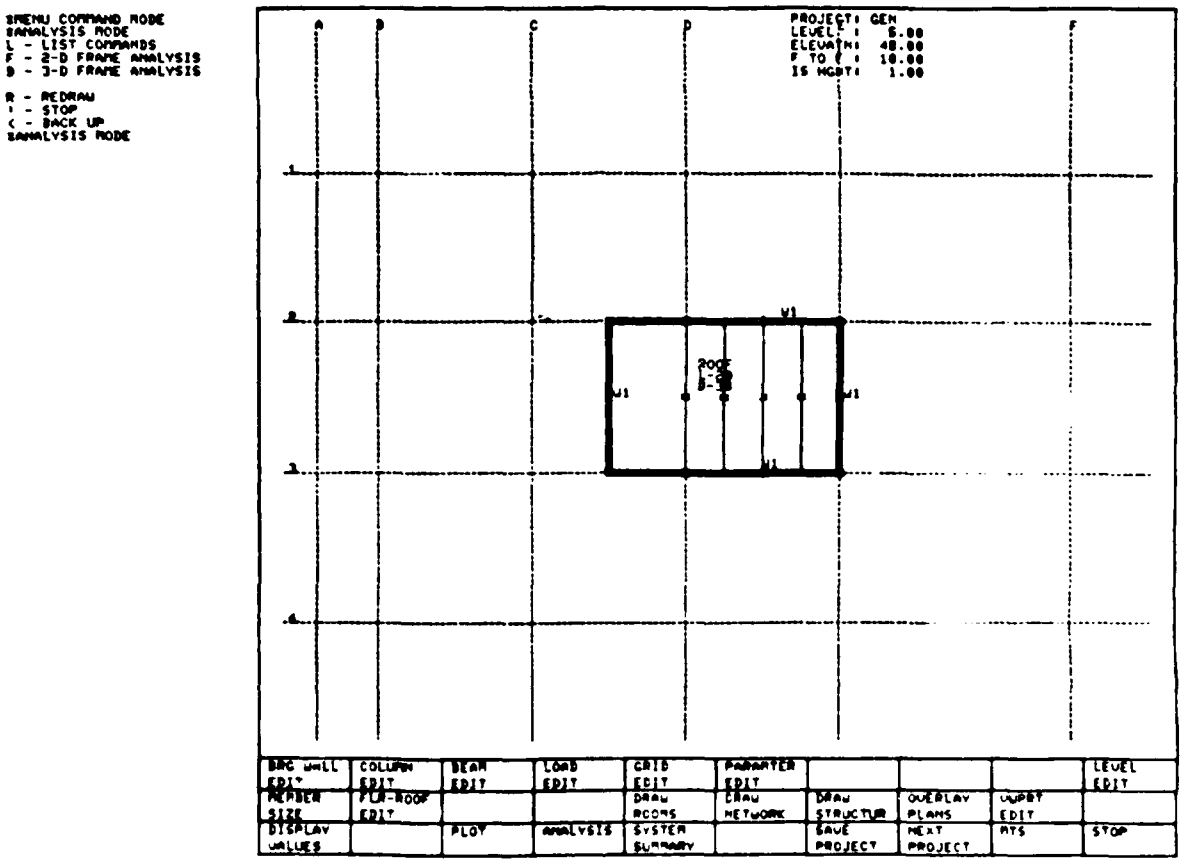


Figure 3. ANALYSIS MODE options

c. Move the cross hairs to the reference line containing the frame desired for further analysis/design and push any key. The program will respond with "FRAME X OK?" (Figure 4) where "X" is the selected reference line. A "YES" answer will cause the frame elevation to be drawn. A "NO" response will result in the user being prompted to "LOCATE REFERENCE LINE".

d. After the frame elevation is drawn, move the cross hairs to the menu area box labeled "PREPARE DECK" and press any key (Figure 5). The system will respond with "ENTER FILE NAME:".

e. Type in the name of the file for the 3-D frame data and press return key (Figure 6). The program will update the user regarding what data are currently being generated. When all data have been generated for the selected frame, the program responds with "======> DATAFILE COMPLETED AND SAVED. <======".

f. Move the cross hairs to the menu area box labeled "RETURN" and press any key.

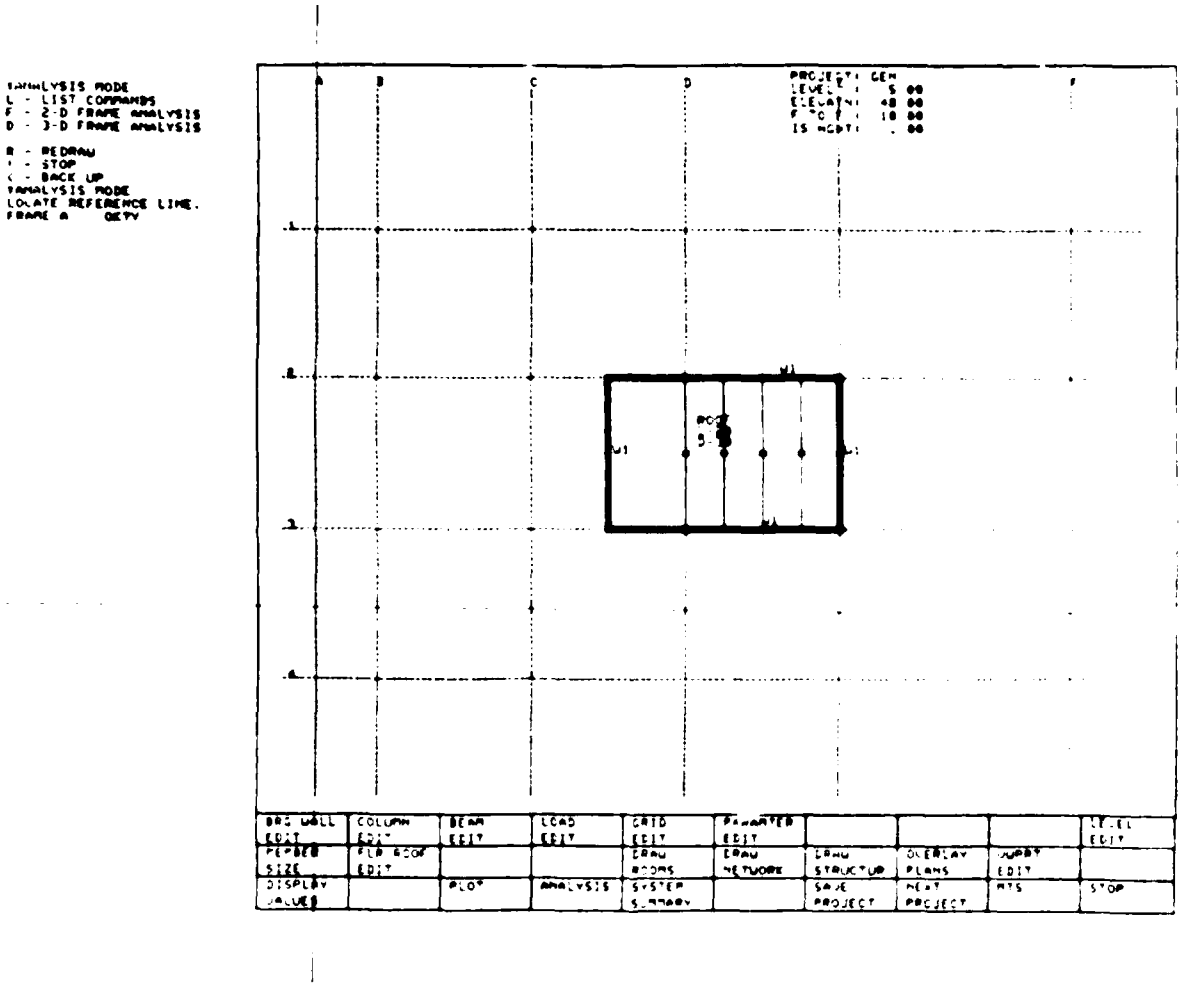


Figure 4. REFERENCE LINE selection

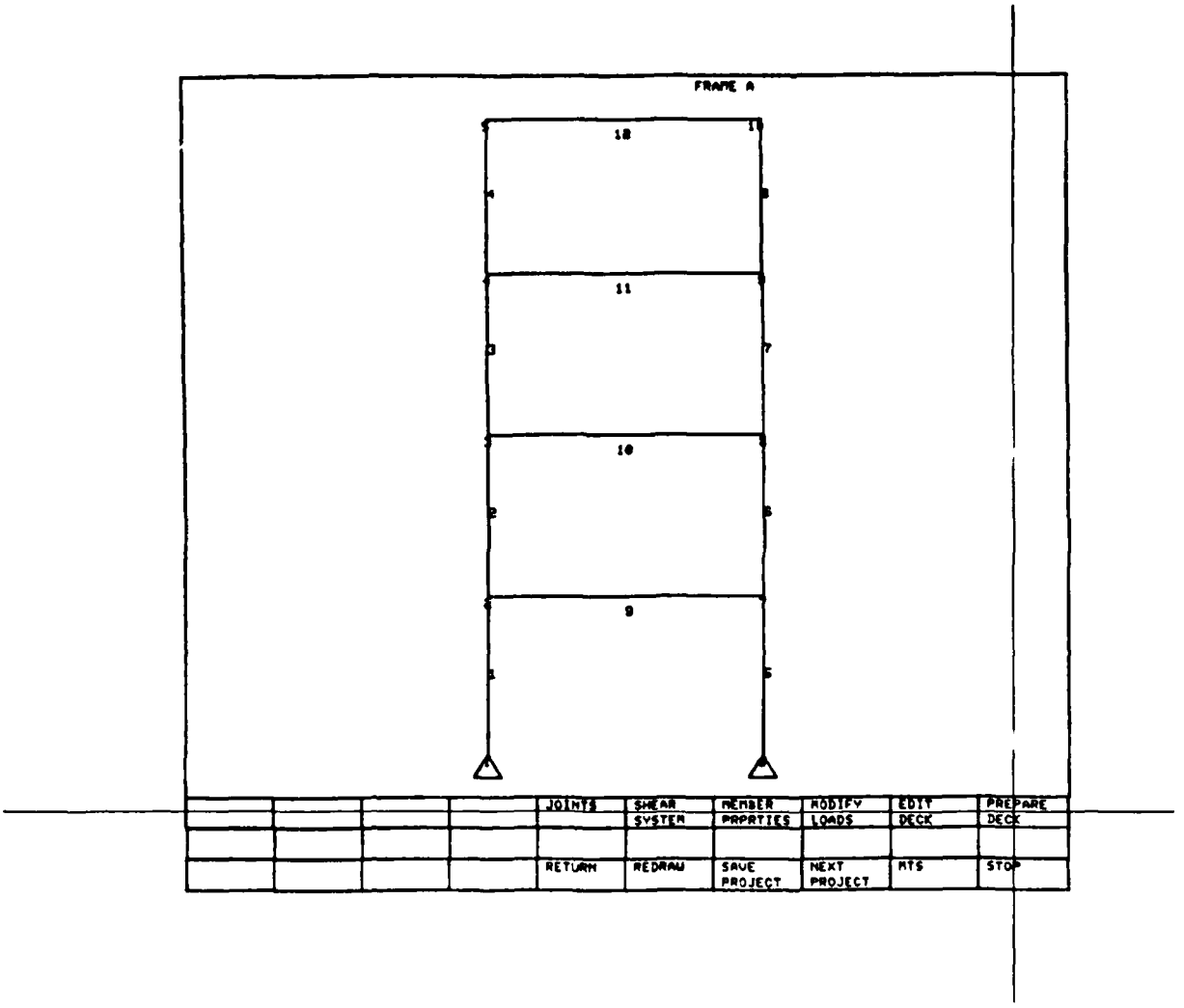


Figure 5. PREPARE DECK selection

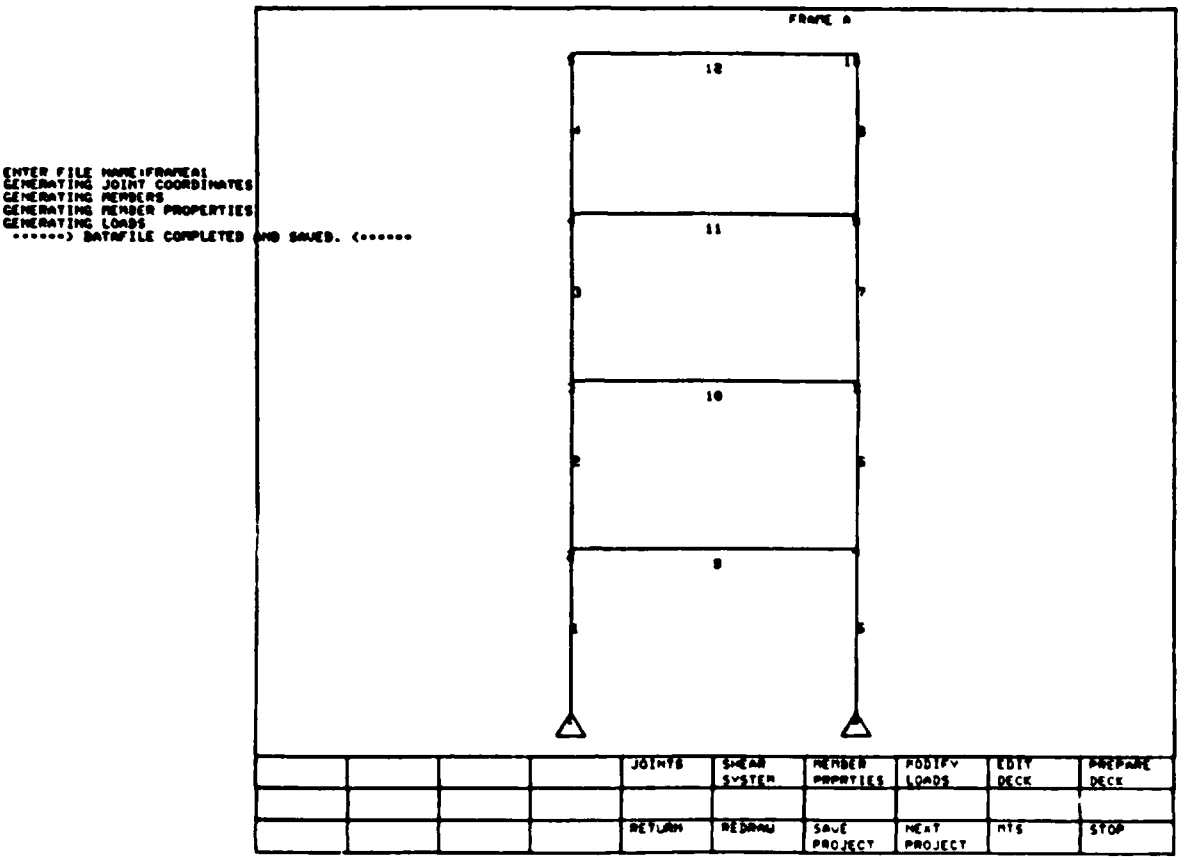


Figure 6. Generating frame data

g. The current level floor plan will be drawn. Since the program is still in "*ANALYSIS MODE", other reference lines may be selected for frame data generation or the program may be stopped.

6. The result of the steps in paragraph 5, a typical data file created from STRUCTURE, is shown in Appendix A.

LINK2D Usage

Overview

7. Data files created in STRUCTURE are input files for LINK2D. Not all information required by CFRAME and GTSTRUDL can be extracted from the STRUCTURE data base. LINK2D has default values for these items or the user may interactively supply these data. Interactive data input must be in the proper format of the target frame analysis program. Refer to the appropriate frame analysis user's guide for the data format.

8. The default values for LINK2D are shown as follows:

a. YES/NO questions without a response default to NO.

b. Flange area is excluded from the shear area.

c. Young's modulus is 29×10^6 psi* and Poisson's ratio is 0.3.

d. Supports are pinned.

e. Load case combinations with combination factors of one are assumed to combine the three load cases extracted from the STRUCTURE data base. The three load cases are dead loads, live loads, and structural loads.

f. Force units are assumed to be pounds with moments in foot-pounds. Specified joint displacements and member properties are in inches. GTSTRUDL (sometimes referred to as STRUDL) allows changes in units while CFRAME does not.

Program usage

9. The initial and general steps for using LINK2D are listed and described in the following subparagraphs.

a. ENTER DESIRED 2-D FRAME FORMAT (CFRAME/STRUDL):

Enter the program name of the desired 2-D structural analysis/design program. Currently, only CFRAME and GTSTRUDL are available.

b. DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY? (Y/N).

Provide a "YES" answer for interactive prompting or a "NO" answer to accept all program defaults. Note the user can also use the computer system editor to modify a data file.

c. ENTER INPUT FILE NAME:

Enter the name given to the file containing the 2-D frame data extracted from STRUCTURE (paragraph 5e of this guide).

d. ENTER OUTPUT FILE NAME:

Enter the name for the file that will contain the output from LINK2D. This will be the selected analysis/design program input file.

e. If a "NO" response was given in paragraph 9b, the program will indicate the output file has been saved. If "YES" was given, see paragraph 10 for additional information.

f. DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE? (Y/N)

A "YES" response will cycle through, beginning with paragraph 9a. A "NO" response will terminate LINK2D. The LINK2D output data file may then be used as input to the appropriate 2-D frame analysis/design computer program.

---

* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 4.

10. Interactive input for the CFRAME and GTSTRUDL programs is possible through LINK2D and is described in the following subparagraphs.

a. Use integer data for integer variables (variables beginning with I through N) and real data for real variables.

b. To end data entry for an item, push the carriage return. If no data were on the line when pushed, data for that particular entry will stop.

c. Data entered must be in the appropriate 2-D frame format. For assistance, refer to the appropriate 2-D frame user's guide.

d. For GTSTRUDL format, it is not necessary to enter the STIFFNESS ANALYSIS command interactively.

e. Sample input for CFRAME and GTSTRUDL are shown in Appendixes B and C, respectively.

11. The limitations to LINK2D are listed and discussed in the subparagraphs that follow.

a. Only major axis moments of inertia are used. If minor axis properties are needed, the data file must be edited to reflect the desired values.

b. A sketch or hardcopy of the frame will be helpful if data are to be added to a specific node or member. This will allow correct node identification when adding loads or releasing members or joints.

c. Although the input is free-field, integer numbers are required for integer variables and real numbers are required for real variables.

APPENDIX A: FRAME DATA EXTRACTED FROM STRUCTURE MODULE

1. After the programs (STRUCTURE, LINK2D, CFRAME, and GTSTRUDL) have been meshed together a data file results. A typical data file extracted from STRUCTURE is shown as Figure A1.

```
 10   12    8
  1   20.0000  -12.0000
  2   20.0000    0.0000
  3   20.0000   12.0000
  4   20.0000   24.0000
  5   20.0000   36.0000
  6   40.0000  -12.0000
  7   40.0000    0.0000
  8   40.0000   12.0000
  9   40.0000   24.0000
 10   40.0000   36.0000
  2
  1
  6
  1    1    2
  2    2    3
  3    3    4
  4    4    5
  5    6    7
  6    7    8
  7    8    9
  8    9   10
  9    2    7
 10    3    8
 11    4    9
 12    5   10
 12
  1 W14X 48
  2 W10X 33
  3 W 4X 13
  4 W 6X  9
  5 W10X 33
  6 W14X 48
  7 W10X 33
  8 W 4X 13
  9 W14X 22
 10 W10X 15
 11 W12X 14
 12 W10X 12
DD    9      0.00   660.00    2.00   690.00
DD           2.00   690.00   18.00   690.00
DD          18.00   690.00   20.00   660.00
DD
LD    9      0.00     0.00    2.00   200.00
LD           2.00   200.00   18.00   200.00
LD          18.00   200.00   20.00     0.00
LD
SD    9      0.00    15.00    2.00    95.00
SD           2.00    95.00   18.00    95.00
SD          18.00    95.00   20.00    15.00
SD
DD   10      0.00   660.00    2.00   690.00
DD           2.00   690.00   18.00   690.00
DD          18.00   690.00   20.00   660.00
DD
LD   10      0.00     0.00    2.00   200.00
LD           2.00   200.00   18.00   200.00
LD          18.00   200.00   20.00     0.00
LD
```

Figure A1. STRUCTURE 2-D frame data (Continued)

SD	10	0.00	15.00	2.00	95.00	
SD		2.00	95.00	18.00	95.00	
SD		18.00	95.00	20.00	15.00	
SD						
DD	11	0.00	660.00	2.75	701.25	
DD		2.75	701.25	17.25	701.25	
DD		17.25	701.25	20.00	660.00	
DD						
LD	11	0.00	0.00	2.75	275.00	
LD		2.75	275.00	17.25	275.00	
LD		17.25	275.00	20.00	0.00	
LD						
SD	11	0.00	15.00	2.75	125.00	
SD		2.75	125.00	17.25	125.00	
SD		17.25	125.00	20.00	15.00	
SD						
DD	12	0.00	660.00	2.00	720.00	
DD		2.00	720.00	18.00	720.00	
DD		18.00	720.00	20.00	660.00	
DD						
LD	12	0.00	0.00	2.00	40.00	
LD		2.00	40.00	18.00	40.00	
LD		18.00	40.00	20.00	0.00	
LD						
SD	12	0.00	15.00	2.00	95.00	
SD		2.00	95.00	18.00	95.00	
SD		18.00	95.00	20.00	15.00	
SD						
JL	1	5.10	9.40	4.45	20.00	0.00
JL	1	3.73	4.56	2.16	20.00	12.00
JL	1	3.70	3.63	1.71	20.00	24.00
JL	1	3.30	0.44	1.07	20.00	36.00
JL	1	0.00	0.00	0.06	20.00	48.00
JL	1	5.08	9.34	4.39	40.00	0.00
JL	1	3.73	4.60	2.10	40.00	12.00
JL	1	3.69	3.69	1.65	40.00	24.00
JL	1	3.30	0.44	1.01	40.00	36.00
JL	1	0.00	0.00	0.06	40.00	48.00

Figure A1. (Concluded)

APPENDIX B: LINK2D-CFRAME USAGE AND FILES

1. By externally linking STRUCTURE design level data with those of program CFRAME, LINK2D makes it possible to create input data for CFRAME. An example of such input is shown as Figure B1.

```
LINK2D

THIS PROGRAM WILL,ALONG WITH ADDITIONAL INPUT,
CONVERT THE CAEADS OUTPUT FILE INTO
A CFRAME OR STRUDL 2-D INPUT FILE.

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
CFRAME


DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)
NO

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMAC1


OUTPUT FILE SAVED = FRAMAC1
DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
Y

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
C


DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)
Y

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMAC2

WHEN ENTERING DATA,AN * CAN BE USED
FOR LINE CONTINUATION. TO TERMINATE
DATA ENTRY FOR AN ITEM PUSH THE RETURN
KEY. Y/N QUESTIONS WILL DEFAULT TO NO
IF A RESPONSE IS NOT ENTERED. FOR MORE
ASSISTANCE CONSULT THE CFRAME USER'S GUIDE.

 I. TITLE. AT LEAST ONE LINE MUST BE USED FOR A PROBLEM TITLE.
A MAXIMUM OF 3 TITLE LINES MAY BE USED.
FRAME A TEST *
INTERACTIVE RESPONSE

 II. UNITS. UE UJ UM UD UF
DEFAULT PARAMETERS ARE: KSI FT IN IN LBS
DO YOU WISH TO CHANGE ANY OF THESE PARAMETERS?(Y/N)

 III. MASTER CONTROL. NJ NM NLC E POI
ENTER : NUMBER OF LOAD CASES TO BE ADDED.
```

Figure B1. LINK2D-CFRAME Input (Continued)

```
1
DEFAULT VALUES ARE:
 E = 29000. KSI
 POI = .3
DO YOU WISH TO MODIFY THESE PARAMETERS?(Y/N)


 IV. JOINT COORDINATES. JN X Y
** AUTOMATICALLY EXTRACTED FROM CAEADS. **

 VI. JOINT FIXITY. 'FIX X' LIST,'FIX Y'LIST,'FIX R',LIST
FIX KX' KX LIST,'FIX KY' KY LIST, 'FIX KR' KR LIST

JOINTS   1  6
ARE ASSUMED TO BE PINNED SUPPORTS.
DO YOU WISH TO MODIFY SUPPORT FIXITY ? (Y/N)


 VII. SPECIFIED JOINT DISPLACEMENTS. 'SD' DX DY DR LIST.
ENTER DISPLACEMENTS :

 VIII. MEMBER INCIDENCES. MN JNA JNB,MN JNA JNB,...
** AUTOMATICALLY EXTRACTED FROM CAEADS. **

 X. PINNED END MEMBERS. 'PINA' LIST,'PINB',LIST
ENTER PINNED END DATA :


 XI. MEMBER PROPERTIES. I A AS LIST
IS THE FLANGE AREA TO BE INCLUDED
IN THE SHEAR AREA ? (Y/N):
NO
** AUTOMATICALLY EXTRACTED FROM CAEADS. **

 XII. MATERIAL PROPERTIES. 'E' E POI LIST,...
ENTER MATERIAL PROPERTIES :


 XIII.THRU XVII. LOADING DATA
** LOAD CASES 1 THRU 3 WERE AUTOMATICALLY EXTRACTED FROM CAEADS. **
YOU HAVE SPECIFIED 1 ADDITIONAL LOAD CASE.
ENTER LOAD CASE DATA : BEGINNING WITH LOAD CASE 4 AND ENDING WITH LOAD CASE 4.
LOAD CASE 4 0 0 0 1 HORIZONTAL LOAD
5000. 0. 0. 5


 XIX. LOAD CASE COMBINATION. 'COMBINATION' LCN LCN1 C1,LCN2 C2,...,TITLE
ENTER COMBINATION DATA : (BEGIN WITH LCN=    5)
COMBINATION 5 1 1 2 1 3 1 4 1 ALL LOADS COMBINED



OUTPUT FILE SAVED = FRAMAC2
DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
NO
STOP
 LINK2D COMPLETE
```

Figure B1. (Concluded)

2. The LINK2D default values for information required by CFRAME that cannot be extracted from the STRUCTURE data base can be seen as Figure B2.

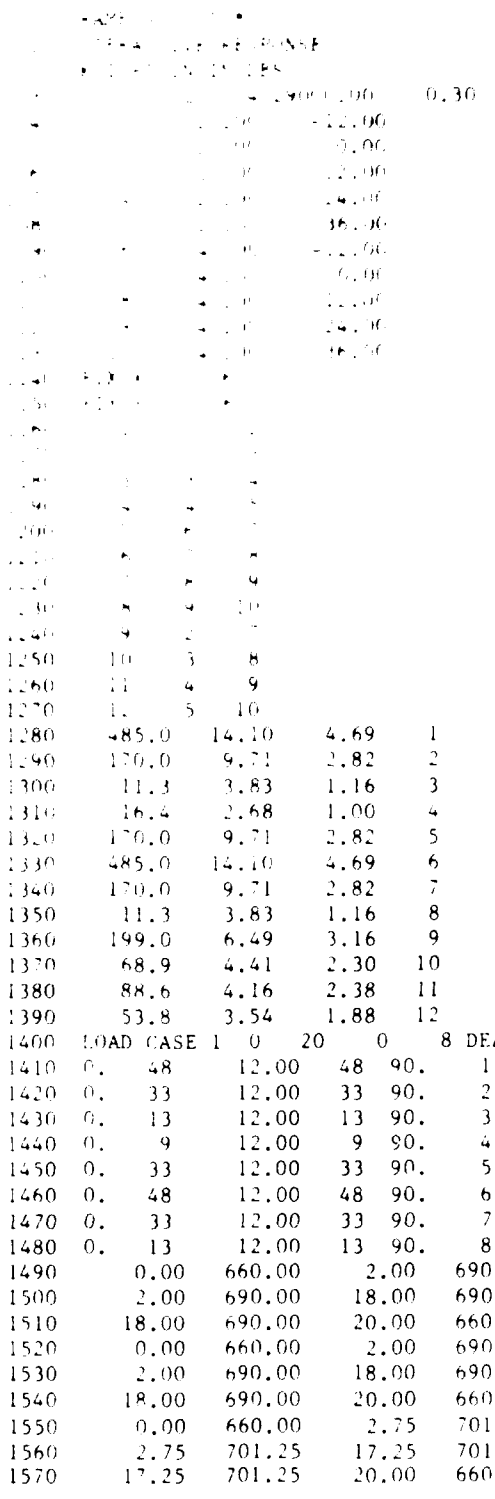
```
1000  TITLE
1010  KSI FT IN IN LBS
1020    10   12    3 29000.00    0.30
1030     1     20.00    -12.00
1040     2     20.00      0.00
1050     3     20.00     12.00
1060     4     20.00     24.00
1070     5     20.00     36.00
1080     6     40.00    -12.00
1090     7     40.00      0.00
1100     8     40.00     12.00
1110     9     40.00     24.00
1120    10     40.00     36.00
1130  FIX X   1  6
1140  FIX Y   1  6
1150     1    1    2
1160     2    2    3
1170     3    3    4
1180     4    4    5
1190     5    6    7
1200     6    7    8
1210     7    8    9
1220     8    9   10
1230     9    2    7
1240    10    3    8
1250    11    4    9
1260    12    5   10
1270    485.0   14.10    4.69    1
1280    170.0    9.71    2.82    2
1290     11.3    3.83    1.16    3
1300     16.4    2.68    1.00    4
1310    170.0    9.71    2.82    5
1320    485.0   14.10    4.69    6
1330    170.0    9.71    2.82    7
1340     11.3    3.83    1.16    8
1350    199.0    6.49    3.16    9
1360     68.9    4.41    2.30   10
1370     88.6    4.16    2.38   11
1380     53.8    3.54    1.88   12
1390  LOAD CASE 1  0   20    0    8 DEAD LOADS
1400  0.   48     12.00   48  90.    1
1410  0.   33     12.00   33  90.    2
1420  0.   13     12.00   13  90.    3
1430  0.    9     12.00    9  90.    4
1440  0.   33     12.00   33  90.    5
1450  0.   48     12.00   48  90.    6
1460  0.   33     12.00   33  90.    7
1470  0.   13     12.00   13  90.    8
1480      0.00   660.00     2.00   690.00   0.    9
1490      2.00   690.00    18.00   690.00   0.    9
1500     18.00   690.00    20.00   660.00   0.    9
1510      0.00   660.00     2.00   690.00   0.   10
1520      2.00   690.00    18.00   690.00   0.   10
1530     18.00   690.00    20.00   660.00   0.   10
1540      0.00   660.00     2.75   701.25   0.   11
1550      2.75   701.25    17.25   701.25   0.   11
1560     17.25   701.25    20.00   660.00   0.   11
1570      0.00   660.00     2.00   720.00   0.   12
```

Figure B2. CFRAME default data file (Continued)

```
1580       2.00    720.00     18.00    720.00     0.    12
1590      18.00    720.00     20.00    660.00     0.    12
1600  0.     -5.10 0.      2
1610  0.     -3.73 0.      3
1620  0.     -3.70 0.      4
1630  0.     -3.30 0.      5
1640  0.     -5.08 0.      7
1650  0.     -3.73 0.      8
1660  0.     -3.69 0.      9
1670  0.     -3.30 0.     10
1680  LOAD CASE 2     0   12    0    8 LIVE LOADS
1690       0.00      0.00      2.00    200.00     0.     9
1700       2.00    200.00     18.00    200.00     0.     9
1710      18.00    200.00     20.00      0.00     0.     9
1720       0.00      0.00      2.00    200.00     0.    10
1730       2.00    200.00     18.00    200.00     0.    10
1740      18.00    200.00     20.00      0.00     0.    10
1750       0.00      0.00      2.75    275.00     0.    11
1760       2.75    275.00     17.25    275.00     0.    11
1770      17.25    275.00     20.00      0.00     0.    11
1780       0.00      0.00      2.00     40.00     0.    12
1790       2.00     40.00     18.00     40.00     0.    12
1800      18.00     40.00     20.00      0.00     0.    12
1810  0.     -9.40 0.      2
1820  0.     -4.56 0.      3
1830  0.     -3.63 0.      4
1840  0.     -0.44 0.      5
1850  0.     -9.34 0.      7
1860  0.     -4.60 0.      8
1870  0.     -3.69 0.      9
1880  0.     -0.44 0.     10
1890  LOAD CASE 3     0   12    0    8 STRUCTURAL LOADS
1900       0.00     15.00      2.00     95.00     0.     9
1910       2.00     95.00     18.00     95.00     0.     9
1920      18.00     95.00     20.00     15.00     0.     9
1930       0.00     15.00      2.00     95.00     0.    10
1940       2.00     95.00     18.00     95.00     0.    10
1950      18.00     95.00     20.00     15.00     0.    10
1960       0.00     15.00      2.75    125.00     0.    11
1970       2.75    125.00     17.25    125.00     0.    11
1980      17.25    125.00     20.00     15.00     0.    11
1990       0.00     15.00      2.00     95.00     0.    12
2000       2.00     95.00     18.00     95.00     0.    12
2010      18.00     95.00     20.00     15.00     0.    12
2020  0.     -4.45 0.      2
2030  0.     -2.16 0.      3
2040  0.     -1.71 0.      4
2050  0.     -1.07 0.      5
2060  0.     -4.39 0.      7
2070  0.     -2.10 0.      8
2080  0.     -1.65 0.      9
2090  0.     -1.01 0.     10
2100  COMBINATION 4 1 1 2 1 3 1
```

Figure B2. (Concluded)

3. Properly formatted interactive data files for CFRAME, via the LINK2D linkage, are shown as Figure B3.



```
1250    10     3     8
1260    11     4     9
1270    12     5    10
1280    485.0   14.10    4.69     1
1290    170.0    9.71    2.82     2
1300     11.3    3.83    1.16     3
1310     16.4    2.68    1.00     4
1320    170.0    9.71    2.82     5
1330    485.0   14.10    4.69     6
1340    170.0    9.71    2.82     7
1350     11.3    3.83    1.16     8
1360    199.0    6.49    3.16     9
1370     68.9    4.41    2.30    10
1380     88.6    4.16    2.38    11
1390     53.8    3.54    1.88    12
1400  LOAD CASE 1  0   20     0     8 DEAD LOADS
1410  0.    48      12.00    48  90.     1
1420  0.    33      12.00    33  90.     2
1430  0.    13      12.00    13  90.     3
1440  0.     9      12.00     9  90.     4
1450  0.    33      12.00    33  90.     5
1460  0.    48      12.00    48  90.     6
1470  0.    33      12.00    33  90.     7
1480  0.    13      12.00    13  90.     8
1490       0.00   660.00     2.00   690.00   0.     9
1500       2.00   690.00    18.00   690.00   0.     9
1510      18.00   690.00    20.00   660.00   0.     9
1520       0.00   660.00     2.00   690.00   0.    10
1530       2.00   690.00    18.00   690.00   0.    10
1540      18.00   690.00    20.00   660.00   0.    10
1550       0.00   660.00     2.75   701.25   0.    11
1560       2.75   701.25    17.25   701.25   0.    11
1570      17.25   701.25    20.00   660.00   0.    11
```

Figure B3. CFRAME interactive data file (Continued)

```
1580       0.00    660.00      2.00    720.00     0.     12
1590       2.00    720.00     18.00    720.00     0.     12
1600      18.00    720.00     20.00    660.00     0.     12
1610  0.     -5.10 0.      2
1620  0.     -3.73 0.      3
1630  0.     -3.70 0.      4
1640  0.     -3.30 0.      5
1650  0.     -5.08 0.      7
1660  0.     -3.73 0.      8
1670  0.     -3.69 0.      9
1680  0.     -3.30 0.     10
1690  LOAD CASE 2     0    12     0    8 LIVE LOAD
1700       0.00      0.00      2.00    200.00     0.      9
1710       2.00    200.00     18.00    200.00     0.      9
1720      18.00    200.00     20.00      0.00     0.      9
1730       0.00      0.00      2.00    200.00     0.     10
1740       2.00    200.00     18.00    200.00     0.     10
1750      18.00    200.00     20.00      0.00     0.     10
1760       0.00      0.00      2.75    275.00     0.     11
1770       2.75    275.00     17.25    275.00     0.     11
1780      17.25    275.00     20.00      0.00     0.     11
1790       0.00      0.00      2.00     40.00     0.     12
1800       2.00     40.00     18.00     40.00     0.     12
1810      18.00     40.00     20.00      0.00     0.     12
1820  0.     -9.40 0.      2
1830  0.     -4.56 0.      3
1840  0.     -3.63 0.      4
1850  0.     -0.44 0.      5
1860  0.     -9.34 0.      7
1870  0.     -4.60 0.      8
1880  0.     -3.69 0.      9
1890  0.     -0.44 0.     10
1900  LOAD CASE 3     0    12     0    8 STRUCTURAL LOADS
1910       0.00     15.00      2.00     95.00     0.      9
1920       2.00     95.00     18.00     95.00     0.      9
1930      18.00     95.00     20.00     15.00     0.      9
1940       0.00     15.00      2.00     95.00     0.     10
1950       2.00     95.00     18.00     95.00     0.     10
1960      18.00     95.00     20.00     15.00     0.     10
1970       0.00     15.00      2.75    125.00     0.     11
1980       2.75    125.00     17.25    125.00     0.     11
1990      17.25    125.00     20.00     15.00     0.     11
2000       0.00     15.00      2.00     95.00     0.     12
2010       2.00     95.00     18.00     95.00     0.     12
2020      18.00     95.00     20.00     15.00     0.     12
2030  0.     -4.45 0.      2
2040  0.     -2.16 0.      3
2050  0.     -1.71 0.      4
2060  0.     -1.07 0.      5
2070  0.     -4.39 0.      7
2080  0.     -2.10 0.      8
2090  0.     -1.65 0.      9
2100  0.     -1.01 0.     10
2110  LOAD CASE 4 0 0 0 1 HORIZONTAL LOAD
2120  5000. 0. 0. 5
2130  COMBINATION 5 1 1 2 1 3 1 4 1 ALL 1 ADDS COMBINED
```

Figure B3. (Concluded)

APPENDIX C: LINK2D-GTSTRUDL USAGE AND FILES

1. The LINK2D-GTSTRUDL input generated from STRUCTURE is shown as Figure C1.

```
LINK 2D

THIS PROGRAM WILL, ALONG WITH ADDITIONAL INPUT,
CONVERT THE CAEADS OUTPUT FILE INTO
A CFRAME OR STRUDL 2-D INPUT FILE.

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
STRUDL


DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)


ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMAS1


OUTPUT FILE SAVED = FRAMAS1
DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
Y

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
S


DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)
Y

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMAS2

TO END DATA ENTRY FOR AN ITEM PUSH
RETURN. Y N QUESTIONS WILL DEFAULT
TO NO IF A RESPONSE IS NOT ENTERED.
FOR MORE ASSISTANCE CONSULT THE
STRUDL USER'S MANUALS.

ENTER TITLE LINE.
STRUDL ' INTERACTIVE RESPONSE

DEFAULT INPUT UNITS ARE POUNDS FEET FAHRENHEIT.
DO YOU WISH TO CHANGE UNITS?(Y/N)

STRUDL ASSUMES ALL SUPPORTS ARE FIXED.
ARE SUPPORT CONDITIONS TO BE MODIFIED? Y/N
Y
SUPPORTS ARE:          1          6
ENTER JOINT RELEASE COMMAND.
JOINT RELEASES
( 6 MOMENT Z
```

Figure C1. LINK2D-GTSTRUDL Input (Continued)

```
DEFAULT CONSTANTS ARE:
  DENSITY = 490. PCF
  E =  29000000. PSI
  POI =  .3
DO YOU WISH TO MODIFY OR ADD ANY OTHER CONSTANTS? (Y/N)

ALL REQUIRED DATA HAS BEEN ASSEMBLED.
ENTER ANY ADDITIONAL STRUDL COMMANDS PRIOR TO ANALYSIS.
LOADING 4 ' HORIZONTAL LOADS '
JOINT LOADS
5 FORCE X 5000.

ENTER DESIRED OUTPUT CONTROL DATA
AND DESIGN DATA:
LOADING COMBINATION 5
COMBINE 5 1 1 2 1 3 1 4 1
OUTPUT DECIMAL 5
LIST REACTIONS FORCES DISPLACEMENTS ALL


OUTPUT FILE SAVED = FRAMAS2
DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
NO
STOP
 LINK2D COMPLETE
```

Figure C1. (Concluded)

2. LINK2D default values for information required by GTSTRUDL that cannot be extracted from the STRUCTURE data base can be seen as Figure C2.

```
STRUDL  'CAEADS' 'TITLE'
UNITS POUNDS FEET FAHRENHEIT
TYPE PLANE FRAME
JOINT COORDINATES
   1     20.00    -12.00   S
   2     20.00      0.00
   3     20.00     12.00
   4     20.00     24.00
   5     20.00     36.00
   6     40.00    -12.00   S
   7     40.00      0.00
   8     40.00     12.00
   9     40.00     24.00
  10     40.00     36.00
 JOINT RELEASES
        1         6 MOMENT Z
MEMBER INCIDENCES
   1    1    2
   2    2    3
   3    3    4
   4    4    5
   5    6    7
   6    7    8
   7    8    9
   8    9   10
   9    2    7
  10    3    8
  11    4    9
  12    5   10
 UNITS INCHES
MEMBER PROPERTIES TABLE STEELW78
  1 TABLE 'W14X48'
  2 TABLE 'W10X33'
  3 TABLE 'W4X13'
  4 TABLE 'W6X9'
  5 TABLE 'W10X33'
  6 TABLE 'W14X48'
  7 TABLE 'W10X33'
  8 TABLE 'W4X13'
  9 TABLE 'W14X22'
 10 TABLE 'W10X15'
 11 TABLE 'W12X14'
 12 TABLE 'W10X12'
 UNITS LBS FEET
 CONSTANTS DENSITY 490. ALL
 UNITS LBS INCHES
 CONSTANTS
 E  29000000. ALL
 POI  .3 ALL
 UNIT LBS FEET
DEAD LOADING 1 DIR -Y MEM    1 TO    8
MEMBER LOADS
  9 FOR Y GLO LINEAR WA  -660.00 WB  -690.00 LA     0.00 LB     2.00
  9 FOR Y GLO LINEAR WA  -690.00 WB  -690.00 LA     2.00 LB    18.00
  9 FOR Y GLO LINEAR WA  -690.00 WB  -660.00 LA    18.00 LB    20.00
 10 FOR Y GLO LINEAR WA  -660.00 WB  -690.00 LA     0.00 LB     2.00
 10 FOR Y GLO LINEAR WA  -690.00 WB  -690.00 LA     2.00 LB    18.00
 10 FOR Y GLO LINEAR WA  -690.00 WB  -660.00 LA    18.00 LB    20.00
```

Figure C2. GTSTRUDL default data file (Sheet 1 of 3)

```
 11 FOR Y GLO LINEAR WA  -660.00 WB  -701.25 LA     0.00 LB     2.75
 11 FOR Y GLO LINEAR WA  -701.25 WB  -701.25 LA     2.75 LB    17.25
 11 FOR Y GLO LINEAR WA  -701.25 WB  -660.00 LA    17.25 LB    20.00
 12 FOR Y GLO LINEAR WA  -660.00 WB  -720.00 LA     0.00 LB     2.00
 12 FOR Y GLO LINEAR WA  -720.00 WB  -720.00 LA     2.00 LB    18.00
 12 FOR Y GLO LINEAR WA  -720.00 WB  -660.00 LA    18.00 LB    20.00
JOINT LOADS
  2 FORCE Y    -5.10
  3 FORCE Y    -3.73
  4 FORCE Y    -3.70
  5 FORCE Y    -3.30
  7 FORCE Y    -5.08
  8 FORCE Y    -3.73
  9 FORCE Y    -3.69
 10 FORCE Y    -3.30
LOADING 2 'LIVE LOAD'
MEMBER LOADS
  9 FOR Y GLO LINEAR WA     0.00 WB  -200.00 LA     0.00 LB     2.00
  9 FOR Y GLO LINEAR WA  -200.00 WB  -200.00 LA     2.00 LB    18.00
  9 FOR Y GLO LINEAR WA  -200.00 WB     0.00 LA    18.00 LB    20.00
 10 FOR Y GLO LINEAR WA     0.00 WB  -200.00 LA     0.00 LB     2.00
 10 FOR Y GLO LINEAR WA  -200.00 WB  -200.00 LA     2.00 LB    18.00
 10 FOR Y GLO LINEAR WA  -200.00 WB     0.00 LA    18.00 LB    20.00
 11 FOR Y GLO LINEAR WA     0.00 WB  -275.00 LA     0.00 LB     2.75
 11 FOR Y GLO LINEAR WA  -275.00 WB  -275.00 LA     2.75 LB    17.25
 11 FOR Y GLO LINEAR WA  -275.00 WB     0.00 LA    17.25 LB    20.00
 12 FOR Y GLO LINEAR WA     0.00 WB   -40.00 LA     0.00 LB     2.00
 12 FOR Y GLO LINEAR WA   -40.00 WB   -40.00 LA     2.00 LB    18.00
 12 FOR Y GLO LINEAR WA   -40.00 WB     0.00 LA    18.00 LB    20.00
JOINT LOADS
  2 FORCE Y    -9.40
  3 FORCE Y    -4.56
  4 FORCE Y    -3.63
  5 FORCE Y    -0.44
  7 FORCE Y    -9.34
  8 FORCE Y    -4.60
  9 FORCE Y    -3.69
 10 FORCE Y    -0.44
LOADING 3 'STRUCTURAL LOADS'
MEMBER LOADS
  9 FOR Y GLO LINEAR WA   -15.00 WB   -95.00 LA     0.00 LB     2.00
  9 FOR Y GLO LINEAR WA   -95.00 WB   -95.00 LA     2.00 LB    18.00
  9 FOR Y GLO LINEAR WA   -95.00 WB   -15.00 LA    18.00 LB    20.00
 10 FOR Y GLO LINEAR WA   -15.00 WB   -95.00 LA     0.00 LB     2.00
 10 FOR Y GLO LINEAR WA   -95.00 WB   -95.00 LA     2.00 LB    18.00
 10 FOR Y GLO LINEAR WA   -95.00 WB   -15.00 LA    18.00 LB    20.00
 11 FOR Y GLO LINEAR WA   -15.00 WB  -125.00 LA     0.00 LB     2.75
 11 FOR Y GLO LINEAR WA  -125.00 WB  -125.00 LA     2.75 LB    17.25
 11 FOR Y GLO LINEAR WA  -125.00 WB   -15.00 LA    17.25 LB    20.00
 12 FOR Y GLO LINEAR WA   -15.00 WB   -95.00 LA     0.00 LB     2.00
 12 FOR Y GLO LINEAR WA   -95.00 WB   -95.00 LA     2.00 LB    18.00
 12 FOR Y GLO LINEAR WA   -95.00 WB   -15.00 LA    18.00 LB    20.00
```

Figure C2. (Sheet 2 of 3)

```
JOINT LOADS
  2 FORCE Y    -4.45
  3 FORCE Y    -2.16
  4 FORCE Y    -1.71
  5 FORCE Y    -1.07
  7 FORCE Y    -4.39
  8 FORCE Y    -2.10
  9 FORCE Y    -1.65
 10 FORCE Y    -1.01
STIFFNESS ANALYSIS
LOAD COMBINATION 4
COMBINE 4 1 1 2 1 3 1
LIST REACTIONS FORCES DISPLACEMENTS ALL

Finish
```

Figure C2. (Sheet 3 of 3)

3. **Properly formatted interactive data files for GTSTRUDL, via the LINK2D linkage, are shown as Figure C3.**

```
STRUDL  'INTERACTIVE RESPONSE'
 UNITS POUNDS FEET FAHRENHEIT
 TYPE PLANE FRAME
 JOINT COORDINATES
    1     20.00    -12.00   S
    2     20.00      0.00
    3     20.00     12.00
    4     20.00     24.00
    5     20.00     36.00
    6     40.00    -12.00   S
    7     40.00      0.00
    8     40.00     12.00
    9     40.00     24.00
   10     40.00     36.00
JOINT RELEASES
1 6 MOMENT Z
 MEMBER INCIDENCES
   1    1    2
   2    2    3
   3    3    4
   4    4    5
   5    6    7
   6    7    8
   7    8    9
   8    9   10
   9    2    7
  10    3    8
  11    4    9
  12    5   10
 UNITS INCHES
MEMBER PROPERTIES TABLE 'STEELW78'
  1 TABLE 'W14X48'
  2 TABLE 'W10X33'
  3 TABLE 'W4X13'
  4 TABLE 'W6X9'
  5 TABLE 'W10X33'
  6 TABLE 'W14X48'
  7 TABLE 'W10X33'
  8 TABLE 'W4X13'
  9 TABLE 'W14X22'
 10 TABLE 'W10X15'
 11 TABLE 'W12X14'
 12 TABLE 'W10X12'
 UNITS LBS FEET
 CONSTANTS DENSITY 490. ALL
 UNITS LBS INCHES
 CONSTANTS
 E  29000000. ALL
 POI  .3 ALL
 UNIT LBS FEET
DEAD LOADING 1 DIR -Y MEM    1 TO    8
MEMBER LOADS
  9 FOR Y GLO LINEAR WA  -660.00 WB  -690.00 LA     0.00 LB     2.00
  9 FOR Y GLO LINEAR WA  -690.00 WB  -690.00 LA     2.00 LB    18.00
  9 FOR Y GLO LINEAR WA  -690.00 WB  -660.00 LA    18.00 LB    20.00
 10 FOR Y GLO LINEAR WA  -660.00 WB  -690.00 LA     0.00 LB     2.00
 10 FOR Y GLO LINEAR WA  -690.00 WB  -690.00 LA     2.00 LB    18.00
 10 FOR Y GLO LINEAR WA  -690.00 WB  -660.00 LA    18.00 LB    20.00
```

Figure C3. GTSTRUDL interactive data file (Sheet 1 of 3)

```
 11 FOR Y GLO LINEAR WA  -660.00 WB  -701.25 LA     0.00 LB     2.75
 11 FOR Y GLO LINEAR WA  -701.25 WB  -701.25 LA     2.75 LB    17.25
 11 FOR Y GLO LINEAR WA  -701.25 WB  -660.00 LA    17.25 LB    20.00
 12 FOR Y GLO LINEAR WA  -660.00 WB  -720.00 LA     0.00 LB     2.00
 12 FOR Y GLO LINEAR WA  -720.00 WB  -720.00 LA     2.00 LB    18.00
 12 FOR Y GLO LINEAR WA  -720.00 WB  -660.00 LA    18.00 LB    20.00
JOINT LOADS
  2 FORCE Y    -5.10
  3 FORCE Y    -3.73
  4 FORCE Y    -3.70
  5 FORCE Y    -3.30
  7 FORCE Y    -5.08
  8 FORCE Y    -3.73
  9 FORCE Y    -3.69
 10 FORCE Y    -3.30
LOADING 2 'LIVE LOAD'
MEMBER LOADS
  9 FOR Y GLO LINEAR WA     0.00 WB  -200.00 LA     0.00 LB     2.00
  9 FOR Y GLO LINEAR WA  -200.00 WB  -200.00 LA     2.00 LB    18.00
  9 FOR Y GLO LINEAR WA  -200.00 WB     0.00 LA    18.00 LB    20.00
 10 FOR Y GLO LINEAR WA     0.00 WB  -200.00 LA     0.00 LB     2.00
 10 FOR Y GLO LINEAR WA  -200.00 WB  -200.00 LA     2.00 LB    18.00
 10 FOR Y GLO LINEAR WA  -200.00 WB     0.00 LA    18.00 LB    20.00
 11 FOR Y GLO LINEAR WA     0.00 WB  -275.00 LA     0.00 LB     2.75
 11 FOR Y GLO LINEAR WA  -275.00 WB  -275.00 LA     2.75 LB    17.25
 11 FOR Y GLO LINEAR WA  -275.00 WB     0.00 LA    17.25 LB    20.00
 12 FOR Y GLO LINEAR WA     0.00 WB   -40.00 LA     0.00 LB     2.00
 12 FOR Y GLO LINEAR WA   -40.00 WB   -40.00 LA     2.00 LB    18.00
 12 FOR Y GLO LINEAR WA   -40.00 WB     0.00 LA    18.00 LB    20.00
JOINT LOADS
  2 FORCE Y    -9.40
  3 FORCE Y    -4.56
  4 FORCE Y    -3.63
  5 FORCE Y    -0.44
  7 FORCE Y    -9.34
  8 FORCE Y    -4.60
  9 FORCE Y    -3.69
 10 FORCE Y    -0.44
LOADING 3 'STRUCTURAL LOADS'
MEMBER LOADS
  9 FOR Y GLO LINEAR WA   -15.00 WB   -95.00 LA     0.00 LB     2.00
  9 FOR Y GLO LINEAR WA   -95.00 WB   -95.00 LA     2.00 LB    18.00
  9 FOR Y GLO LINEAR WA   -95.00 WB   -15.00 LA    18.00 LB    20.00
 10 FOR Y GLO LINEAR WA   -15.00 WB   -95.00 LA     0.00 LB     2.00
 10 FOR Y GLO LINEAR WA   -95.00 WB   -95.00 LA     2.00 LB    18.00
 10 FOR Y GLO LINEAR WA   -95.00 WB   -15.00 LA    18.00 LB    20.00
 11 FOR Y GLO LINEAR WA   -15.00 WB  -125.00 LA     0.00 LB     2.75
 11 FOR Y GLO LINEAR WA  -125.00 WB  -125.00 LA     2.75 LB    17.25
 11 FOR Y GLO LINEAR WA  -125.00 WB   -15.00 LA    17.25 LB    20.00
 12 FOR Y GLO LINEAR WA   -15.00 WB   -95.00 LA     0.00 LB     2.00
 12 FOR Y GLO LINEAR WA   -95.00 WB   -95.00 LA     2.00 LB    18.00
 12 FOR Y GLO LINEAR WA   -95.00 WB   -15.00 LA    18.00 LB    20.00
```

Figure C3. (Sheet 2 of 3)

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JOINT LOADS
  2 FORCE Y    -4.45
  3 FORCE Y    -2.16
  4 FORCE Y    -1.71
  5 FORCE Y    -1.07
  7 FORCE Y    -4.39
  8 FORCE Y    -2.10
  9 FORCE Y    -1.65
 10 FORCE Y    -1.01
LOADING 4 ' HORIZONTAL LOADS '
JOINTS LOADS
5 FOR X 5000.
 STIFFNESS ANALYSIS
LOAD COMBINATION 5
COMBINE 5 1 1 2 1 3 1 4 1
OUTPUT DECIMAL 5
LIST REACTIONS FORCES DISPLACEMENTS ALL
Finish
```

Figure C3. (Sheet 3 of 3)

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

	Title	Date
Technical Report K-78-1	List of Computer Programs for Computer-Aided Structural Engineering	Feb 1978
Instruction Report O-79-2	User's Guide: Computer Program with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Mar 1979
Technical Report K-80-1	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report K-80-2	Evaluation of Computer Programs for the Design/Analysis of Highway and Railway Bridges	Jan 1980
Instruction Report K-80-1	User's Guide: Computer Program for Design Review of Curvilinear Conduits/Culverts (CURCON)	Feb 1980
Instruction Report K-80-3	A Three-Dimensional Finite Element Data Edit Program	Mar 1980
Instruction Report K-80-4	A Three-Dimensional Stability Analysis/Design Program (3DSAD):	
	Report 1: General Geometry Module	Jun 1980
	Report 3: General Analysis Module (CGAM)	Jun 1982
	Report 4: Special-Purpose Modules for Dams (CDAMS)	Aug 1983
Instruction Report K-80-6	Basic User's Guide: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Instruction Report K-80-7	User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Technical Report K-80-4	Documentation of Finite Element Analyses:	
	Report 1: Longview Outlet Works Conduit	Dec 1980
	Report 2: Anchored Wall Monolith, Bay Springs Lock	Dec 1980
Technical Report K-80-5	Basic Pile Group Behavior	Dec 1980
Instruction Report K-80-8	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL):	
	Report 1: Computational Processes	Feb 1981
	Report 2: Interactive Graphics Options	May 1981
Instruction Report K-81-1	User's Guide: Computer Programs for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL): Report 3: Free-Earth Support Method (FEWAL)	Jan 1981
Instruction Report K-81-2	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL): Report 4: Beam-Column Method (BCWAL)	May 1981
Instruction Report K-81-3	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL): Report 5: Special Features	May 1981

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

(Concluded)

	Title	Date
Instruction Report K-83-1	User's Guide: Computer Program With Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Jan 1983
Instruction Report K-83-2	User's Guide: Computer Program for Generation of Engineering Geometry (SKETCH)	Jun 1983
Instruction Report K-83-5	User's Guide: Computer Program to Calculate Shear, Moment, and Thrust (CSMT) from Stress Results of a Two-Dimensional Finite Element Analysis	Jul 1983
Technical Report K-83-1	Basic Pile Group Behavior	Sep 1983
Technical Report K-83-3	Reference Manual: Computer Graphics Program for Generation of Engineering Geometry (SKETCH)	Sep 1983
Technical Report K-83-4	Case Study of Six Major General-Purpose Finite Element Programs	Oct 1983
Instruction Report K-84-2	User's Guide: Computer Program for Optimum Dynamic Design of Nonlinear Metal Plates Under Blast Loading (CSDOOR)	Jan 1984
Instruction Report K-84-7	User's Guide: Computer Program for Determining Induced Stresses and Consolidation Settlements (CSETT)	Aug 1984
Instruction Report K-84-8	Seepage Analysis of Confined Flow Problems by the Method of Fragments (CFRAG)	Sep 1984
Instruction Report K-84-11	User's Guide for Computer Program CGFAG, Concrete General Flexure Analysis with Graphics	Sep 1984
Technical Report K-84-3	Computer-Aided Drafting and Design for Corps Structural Engineers	Oct 1984
Technical Report ATC-86-5	Decision Logic Table Formulation of ACI 318-77, Building Code Requirements for Reinforced Concrete for Automated Constraint Processing, Volumes I and II	Jun 1986
Technical Report [illegible]	A Case Committee Study of Finite Element Analysis of Concrete Flat Slabs	Jan 1987
[illegible] Report [illegible]	User's Guide: Computer Program for Two-Dimensional Analysis of U-Frame Structures (CUFRAM)	[illegible]
[illegible] Report [illegible]	User's Guide: For Concrete Strength Investigation and Design (CASTR) in Accordance with ACI 318-83	[illegible]
[illegible]	Finite Element Method Package for [illegible] Problems	[illegible]
[illegible]	User's Guide: A Three Dimensional Stability Analysis/Design Program [illegible]	[illegible]
[illegible]	[illegible]	[illegible]

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